Review

Vol. 68, No. 3 March 1986

THE FEDERAL RESERVE BANK of ST. LOUIS

The Review is published 10 times per year by the Research and Public Information Department of the Federal Reserve Bank of St. Louis. Single-copy subscriptions are available to the public free of charge. Mail requests for subscriptions, back issues, or address changes to: Research and Public Information Department, Federal Reserve Bank of St. Louis, P.O. Box 442, St. Louis, Missouri 63166.

Federal Reserve Bank of St. Louis
Review
March 1986

In This Issue . . .

The efficient markets hypothesis suggests that financial asset prices reflect the information available to market participants. Consequently, anticipated changes in any factors that influence asset prices, like the money stock, should already be accounted for in the quoted interest rates and stock prices. Only unanticipated changes should lead to changes in interest rates and stock prices.

In the first paper in this *Review*, "The Response of Stock Prices to Changes in Weekly Money and the Discount Rate," R. W. Hafer investigates several aspects of the efficient markets hypothesis: Do stock prices react only to unanticipated changes in the money stock? Are the magnitudes of these effects different across different monetary policy procedures? Do different measures of stock prices react differently to a given unexpected change in M1? Are the different stock price measures equally responsive to a given change in the discount rate? Finally, do reactions to discount rate changes vary across monetary policy procedures?

Hafer's results, based on daily data from 1977 through 1979, generally do not reject the efficient markets hypothesis. He does find, however, that the response to an unexpected increase in M1 is different from an unexpected decrease in M1 for the broader stock price measures. Hafer's evidence also indicates that the response to discount rate changes varies across stock price measures and monetary policy procedures.

* * *

While most analysts agree that the recent sharp reduction in the rate of inflation has affected financial institutions, they disagree about the direction of the effect. Some people point to the increase in bank failures as evidence that the sudden drop in inflation has put a great deal of strain on the whole credit structure. Others think that banks have gained from reduced inflation and falling interest rates. In the second article in this *Review*, "The Effects of Inflation on Commercial Banks," G. J. Santoni examines this issue by analyzing the relationship between inflation and the stock prices of publicly traded banks. The author's results indicate that the real share prices of banks fall when the actual rate of inflation is greater than the anticipated rate of inflation. Furthermore, upward revisions in the anticipated rate of inflation are associated with declines in the real share prices of commercial banks. Santoni's evidence suggests that the recent decline in the rate of inflation has had a favorable impact on banks and that any unexpected resurgence of inflation would be harmful to bank stock.

The Response of Stock Prices to Changes in Weekly Money and the Discount Rate

R. W. Hafer

CONSIDERABLE research has been devoted to analyzing the effects of weekly changes in the money stock (M1) on interest rates and exchange rates.[1] In general, the results of this research are consistent with the efficient markets hypothesis, which holds that only unexpected changes in the money stock should significantly affect interest rates and exchange rates.[2] Few of these studies, however, have investigated the reaction of stock prices to the weekly money announcement.[3] The purpose of this article is to provide some evidence on this effect.

This paper extends previous research on the reaction of stock prices to monetary "news" in several ways. First, it covers a broader time period, from September 1977 through December 1984, than most previous studies. This allows one to test whether the changes in monetary policy operating procedures in October 1979 and October 1982 influenced the response of stock prices to changes in the money stock and the discount rate.[4]

Second, unlike previous studies, this study uses both broad and industry-specific measures of stock prices to determine if general market effects also occur uniformily across in specific industry groups.[5] As noted by King (1966):

> ". . . it is intuitively appealing to think of incoming information as falling into various classes according to the scope of its effect on the market. There is some news of a monetary nature, for example, which is bound to have a market-wide impact on security price. The magnitude of impact need not, however, be the same for all stocks." (p. 140)

Although numerous studies have attempted to determine optimal groupings of individual stocks based on their relative movements over time, little has been done to investigate the relative response of different stock groups to the same piece of economic information.

R. W. Hafer is a research officer at the Federal Reserve Bank of St. Louis. *The author would like to thank Stu Allen, Gikas Hardouvelis, Scott Hein, Jan Loeys, Doug Pearce, Jim Schmidt and Jim VanderHoff for their suggestions and comments on earlier drafts of this paper. Thomas A. Pollmann provided research assistance.*

[1]The surveys by Cornell (1983) and Sheehan (1985) contain numerous references to the literature on this subject.

[2]Alternative evidence is presented in Hein (1985), and Falk and Orazem (1985).

[3]Pearce and Roley (1983, 1985) find that stock prices react only to unanticipated changes in money and, for the most part, show no statistical relationship to either unanticipated or expected movements of other economic news. Hardouvelis (1985) reports that stock prices react to unanticipated movements in four monetary measures (M1, net free reserves, the discount rate and the discount rate surcharge), as well as three non-monetary measures (trade deficit, unemployment rate and personal income). Although few studies have examined the weekly money/stock-price relationship, numerous studies have studied the longer-term reaction of stock prices to movements in money. Among others, see Sprinkel (1964), Rozeff (1974), Sorensen (1982) and Davidson and Froyen (1982).

Various studies also have examined the behavior of stock prices to announcements of different types of information. For example, Schwert (1981) examines the reaction of stock prices to the announcement of inflation data; Fama, et. al. (1969) study the effects of stock splits; Lloyd-Davies and Canes (1978) investigate the effects of stock analysts' published recommendations; and Niederhoffer (1971) analyses the reaction of stock prices to "world events."

[4]A discussion of the October 1982 change in policy procedures can be found in Wallich (1984) and Gilbert (1985).

[5]Most previous research focuses solely on the broad market effects. For example, Pearce and Roley (1983) use the Dow Jones Industrial Average while Pearce and Roley (1985) use the Standard and Poor's 500 index. In an approach similar to that used in this study, Hardouvelis examines the effect of new information on several different stock price measures.

Finally, unlike most previous work, which presumed that the reaction of stock prices was symmetric with respect to unanticipated increases or decreases in money, this paper tests for the separate effect of positive and negative unexpected changes in M1. This permits one to test for market efficiency in a somewhat different manner than simply testing for the significance of expected and unexpected changes in money.[6]

THEORETICAL MODELS OF STOCK PRICE RESPONSE TO MONETARY NEWS

The efficient markets hypothesis suggests that, when expected changes in the money stock occur, they have no significant effect on stock prices because they already have been incorporated into security prices. Only unexpected changes in the money stock affect stock prices according to this hypothesis.[7]

Weekly Money Changes

Several hypotheses have been suggested to explain why stock prices react to unexpected changes in the money stock.[8] The *expected inflation hypothesis* suggests that an unexpected increase in the money stock increases market participants' expectations of inflation, leading to higher interest rates via the so-called Fisher effect. If the increase in interest rates lowers the present value of corporations' discounted cash flows, stock prices will fall whenever investors observe an unexpected increase in the money stock. This hypothesized response does not occur, however, under certain restrictive conditions. Given perfect markets and no taxes, for example, changes in expected inflation would have no effect on stock prices, because expected increases in nominal cash flows would offset the effect of increases in the rate at which those flows are discounted.[9] A large literature addresses these conditions, showing that they generally are not fulfilled.[10] Based on these studies, which indicate that stock prices react negatively to inflation, the expected inflation hypothesis suggests that stock prices should fall following the announcement of an unexpected increase in the money stock.

An alternative hypothesis, the *policy anticipations hypothesis*, views an unexpected change in the money stock as a signal that alters market perceptions of future monetary policy. Presuming that the change is perceived as permanent or that the Federal Reserve is slow to respond to unexpected deviations in the money stock away from its target level, interest rates will rise as the public expects the Fed to offset the unexpected increase in the money stock. Consequently, an unexpected increase in the money stock implies greater future tightening of credit availability, which results in higher interest rates. Because the higher interest rates reduce the present value of discounted cash flows, stock prices are hypothesized to decline.

Finally, the *money demand* or *real activity hypothesis* asserts that money announcements provide information about future money demand. Suppose that market participants interpret an unexpected increase in the money stock as a signal that there has been a permanent increase in money demand. If money demand depends on expected future output, then the unexpected increase in money demand indicates that future output will be higher than previously expected.[11] Consequently, the increase in expected cash

[6]Cornell, Pearce and Roley (1985) and Hardouvelis provide no evidence on this issue as it relates to stock price effects. Pearce and Roley (1983) present evidence on the response of stock prices when money deviates from announced long-run target ranges. Their tests are based on separating unanticipated money into positive surprises above target, negative surprises below target and all others. In general, their results indicate that the different surprise measures are not statistically different in their effect. There is, however, some evidence of a different effect of positive surprises across the different policy regimes.

[7]As Sheehan (1985) notes, the unexpected change in the money stock provides new information about money stock developments that already have occurred. That is because the money stock is announced with a lag. Thus, the announcement causes market participants to revise their forecasts for future policy actions apart from previously held expectations only if the announced money stock change is different from its expected change.

[8]This discussion is based on Cornell and Sheehan.

[9]This discussion abstracts from the distinction of net monetary creditors and net monetary debtors. For a discussion of the effects of changes in inflation expectations on each group, see Kessel and Alchian (1962). For a more recent study of the effects of inflation on bank stock prices, used to represent a group of net monetary creditors, see Santoni (1986).

[10]For example, Feldstein (1980) discusses the effect of taxes; Schwert (1981), Fama and Schwert (1977) and Nelson (1976) examine the inflation-stock price relationship for the United States while Branch (1974) and Cohn and Lessard (1981) provide evidence from other countries. In general, these studies indicate that unexpected increases in inflation lower stock prices. Results reported in Kool and Hafer (1986), however, suggest that this result does not hold for earlier time periods.

[11]Fama (1981) argues that expected inflation in previous studies serves as a proxy for expected real activity. Consequently, regressing stock prices on expected inflation without accounting for expected real activity will yield incorrect estimates. Following this line of reasoning, several researchers have used available survey data to study the relationship between expected stock price changes, expected inflation and expected real activity. See, for example, Gultekin (1983), Pearce (1984), Hasbrouck (1984) and Coate and VanderHoff (1985).

flows produces an increase in stock prices.[12] This hypothesis thus predicts that stock prices should increase in response to an unexpected increase in the money stock.

Discount Rate Changes

Discount rate changes may be thought of as an indication of changes in expected future monetary policy; discount rate changes, in other words, affect financial and stock markets primarily through their effect on interest rates and perceptions of future economic activity.[13] In general, increases in the discount rate reduce stock prices because they presage a tightening of monetary policy.[14] The move toward tighter policy is expected to increase interest rates and reduce real economic activity and, consequently, future corporate cash flows. Stock prices decline because the reduced future cash flows are discounted at higher interest rates.

Some argue that the impact of a discount rate change depends on the Federal Reserve's current operating procedure.[15] If the Fed is targeting interest rates, changes in the discount rate may provide no information about future policy that is not already incorporated in interest rates. If the Fed is using a reserve growth operating procedure, however, changes in the discount rate influence interest rates. During the period covered by this study, three different operating procedures were used: interest rate targeting (pre-October 1979); nonborrowed reserves targeting (October 1979 to October 1982); and a borrowed reserves procedure, which tends to smooth movements in the funds rate more than nonborrowed reserves targeting (post-October 1982). The empirical tests below assess the different effects of discount rate changes under different policy procedures.

TESTS OF THE BASIC MODEL

The basic equation tested is:

$$(1)\ \Delta SP_t = \alpha_0 + \beta_1 UM_t + \beta_2 EM_t + \beta_3 DR_t + \beta_4 DRS_t + \varepsilon_t,$$

where

ΔSP = the first-difference of the logarithm of the daily stock price index,

UM = the unexpected dollar change in M1,

EM = the expected change in M1,

DR = the change in the discount rate, and

DRS = the change in the discount rate surcharge.[16]

The efficient markets hypothesis suggests that the estimated coefficient on expected money changes (β_2) should be zero. If discount rate changes influence stock prices as hypothesized above, β_3 and β_4 will be negative. Finally, the expected sign of β_1 differs depending upon the hypothesis being tested. The policy anticipations and the expected inflation hypotheses suggest that it will be negative; the money demand hypothesis suggests that it will be positive.

Besides investigating the validity of several hypotheses regarding the effects of money stock and discount rate changes on stock prices, estimates of equation 1 can be used to test several other hypotheses as well: Are the effects of the explanatory variables statistically equal across different monetary policy regimes? Are the effects similar across stock price indexes? Are the effects of money stock changes on stock prices symmetrical, as generally is assumed?

[12]It should be noted that attendant increases in the *ex ante* real rate are presumably more than offset by expected increases in future real economic activity.

[13]Batten and Thornton (1985) and Smirlock and Yawitz (1985), for example, each attempt to determine "technical" from "non-technical" changes in the discount rate. Batten and Thornton dichotomize discount rate changes into technical or policy-related, based on Federal Reserve statements. Their procedure assumes that the change is entirely technical or policy-related.

Smirlock and Yawitz attempt to define technical and non-technical discount rate changes by regressing rate changes on lagged values of the spread between the federal funds rate and the discount rate and lagged values of changes in discount window borrowing. Predicted values from this equation constitute the technical (or anticipated) change, while the regression's error term constitutes the non-technical (or unanticipated) change in the discount rate.

Several factors militate against this procedure. First, it does not capture effects not incorporated in the explanatory variables. Second, it may alter the timing of the actual change. Last, it assigns each discount rate change, which generally is 25, 50 or 100 basis points, some estimated value that often does not equal the actual value. In other words, there is always some non-technical change.

Because of the problems surrounding these classifications of discount rate changes, we take the changes to be unanticipated.

[14]There are instances, however, when moves to raise the discount rate have been received by the market as *good* news, precipitating increases in stock prices. This is discussed in the shaded box on the next page.

[15]For example, see Roley and Troll (1984) or Smirlock and Yawitz for a discussion of this point.

[16]The discount rate surcharge was used by the Federal Reserve during the period from March to May 1980 and again during the period from November 1980 to November 1981. The 1980 imposition of the surcharge was part of the credit restraint program enacted by the Carter administration and it was set at 3 percent. During each period when the surcharge was used, it applied to discount window borrowings by banks with deposits of $500 million or more that borrow frequently. Because the surcharge did not apply to all borrowing, it is included as a separate variable in the regression equations presented below.

Timing Discount Rate Changes

Studies using discount rate changes often take the announcement date as the day it becomes "public." How one times the publication of the new information, however, may alter the empirical results. For example, there are occasions on which discount rate changes are announced *during* the trading day and, as such, the actual announcement day will differ from the day it is reported by the financial press. Because of this, we enter the discount rate change on the trading day that the change becomes effective.

To illustrate how sensitive the results are to changes in the timing, the SP500 equation was reestimated for the pre-October 1979 period, defining the announcement date as that day when the discount rate change appeared in the the *Wall Street Journal.* An examination of the data revealed that, on Friday, November 1, 1978, the discount rate was raised 100 basis points *during* the trading day. Accounts in the *Wall Street Journal* on Monday attribute the stock price rally on Friday to the announcement, suggesting that the increase in the discount rate reaffirmed the market's perception that the Fed was resolved to rein in money growth and to reduce the possibility of future inflation. If we change only this one announcement date from the day it became effective (Friday) to the day it appeared in the *Wall Street Journal* (Monday), the estimated relationship becomes

$$\Delta SP500_t = \underset{(1.14)}{0.04} - \underset{(2.18)}{0.098}\, UM_t - \underset{(2.05)}{0.872}\, DR_t$$

$$\bar{R}^2 = 0.015 \quad SE = 0.713 \quad DW = 1.68$$

Two points should be made. First, the use of the effective day is theoretically preferable to dating the announcement by its appearance in the financial press. Second, the empirical effects of discount rate changes on stock prices appear to be quite sensitive to small timing changes. In this example, changing one observation reverses the sign and significance of the discount rate variable.

To assess these questions, equation 1 was estimated using daily stock price data from September 23, 1977, through December 31, 1984. Three zero-one dummy variables were used to differentiate the periods associated with alternative monetary policy regimes. Thus, D1 = 1 from September 23, 1977, through October 5, 1979, zero elsewhere; D2 = 1 from October 5, 1979, through October 15, 1982, zero elsewhere; and D3 = 1 after October 15, 1982, zero elsewhere. Interaction terms are formed by multiplying each explanatory variable by these dummy variables.[17] For example, D1UM represents the effect of UM in the first subperiod, D2UM the effect during the second and so on. Table 1 presents the results of estimating equation 1 using these interaction terms and the various stock price indexes.[18]

As the efficient markets hypothesis predicts, the expected change in M1 (EM) does not significantly affect stock price changes. The results in table 1 indicate that none of the 15 estimated coefficients on expected money is statistically significant at the 5 percent level of significance. The test results in table 2 also bear out the efficient markets hypothesis, as the reported F-statistics cannot reject the hypothesis that the coefficients on the expected change in money together are insignificantly different from zero. Thus, the hypothesis that the estimated coefficients on expected money are zero *across the different monetary regimes* is not rejected by the data.

As predicted by the expected inflation and policy anticipations hypotheses, but counter to the money

[17]Because the discount rate surcharge variable enters only during the second subsample, no interaction term is necessary. Also, the choice of October 15 for the 1982 policy change is arbitrary, since published accounts of the procedural change do not provide an exact date.

[18]Note that equation 1 is estimated without day-of-the-week variables. Previous analysis by Pearce and Roley (1985) using the same data finds that the presence or absence of these variables did not influence their results. Given this evidence and the fact that we are using the same data, we also omit day-of-the-week variables. Other evidence on the existence of day-of-the-week effects, much of it conflicting, are reported in French (1980) and Gibbons and Hess (1981).

Following Pearce and Roley (1985) and Hardouvelis, we also included several other measures of economic "news" as explanatory variables in equation 1. Those results indicated that stock prices, irrespective of the index, responded to monetary announcements more reliably than the other measures, such as unexpected inflation, economic activity or unemployment. Because the results of these tests do not extend the analysis already provided by Pearce and Roley, we do not report them here.

Table 1

Estimates of Equation 1

	Index				
Variable	SP500	SP400	SPTRAN	SPUTIL	SPFIN
Constant	0.025	0.025	0.027	0.012	0.018
	(1.20)	(1.14)	(0.98)	(0.86)	(0.80)
D1UM	−0.100	−0.104	−0.164	−0.037	−0.060
	(1.81)	(1.81)	(2.29)	(1.02)	(1.03)
D2UM	−0.124	−0.120	−0.067	−0.129	−0.149
	(3.84)	(3.58)	(1.60)	(6.05)	(4.37)
D3UM	−0.112	−0.114	−0.091	−0.119	−0.125
	(2.46)	(2.41)	(1.54)	(3.96)	(2.60)
D1EM	0.072	0.077	0.105	0.036	0.033
	(1.14)	(1.18)	(1.29)	(0.87)	(0.50)
D2EM	0.072	0.073	0.101	0.048	0.031
	(1.37)	(1.34)	(1.49)	(1.40)	(0.56)
D3EM	0.034	0.037	−0.021	0.022	0.094
	(0.74)	(0.77)	(0.34)	(0.72)	(1.92)
D1DR	0.916	1.038	1.189	0.259	0.944
	(1.77)	(1.91)	(1.76)	(0.76)	(1.72)
D2DR	−0.597	−0.599	−0.332	−0.282	−0.448
	(2.35)	(2.27)	(1.01)	(1.69)	(1.67)
D3DR	1.208	1.315	1.412	−0.269	0.336
	(1.54)	(1.61)	(1.38)	(0.52)	(0.41)
DRS	−0.432	−0.421	−0.501	−0.543	−0.658
	(2.66)	(2.48)	(2.36)	(5.08)	(3.83)
$\bar{R}^2$	0.020	0.018	0.009	0.039	0.021
SE	0.877	0.913	1.165	0.596	0.952
DW	1.79	1.82	2.00	1.98	2.01
ρ	—	—	0.19	0.26	0.23
			(8.31)	(11.36)	(9.88)

NOTE: Absolute value of t-statistics are reported in parentheses. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom; SE is the regression standard error; DW is the Durbin-Watson test statistic; and ρ is the estimate of the first-order serial correlation coefficient. The dependent variables are measured as first-differences of the logarithms of Standard and Poor's 500 (SP500), 400 stock index (SP400), the transportation index (SPTRAN), the utility index (SPUTIL) and the financial index (SPFIN). The right-hand-side measures are unexpected changes (UM) and expected changes in M1 (EM), based on the Money Market Services, Inc. survey. DR and DRS represent the percentage change in the Federal Reserve's discount rate and surcharge rate, respectively. The terms D1, D2 and D3 represent (0, 1) dummy variables where D1 = 1 from September 23, 1977, through October 5, 1979, 0 elsewhere; D2 = 1 from October 5, 1979, through October 15, 1982, 0 elsewhere; and D3 = 1 from October 15, 1982, to December 31, 1984, 0 elsewhere.

demand hypothesis, unanticipated changes in M1 (UM) generally have a statistically significant, negative impact on stock prices. For instance, an unanticipated $1 billion increase in M1 reduced the growth rate of the SP500 and the SP400 by about 10, 12 and 11 basis points across the three periods tested. The results in table 2 provide supporting evidence that unanticipated money stock changes do affect stock prices. The results on line 3 reject the claim that unanticipated changes in M1 have no effect; the results on line 4, which test the equality of the estimated coefficients across the different policy periods, indicate that one cannot reject coefficient stability at the 5 percent level. These results show that only unexpected changes in

Table 2
Hypothesis Test Results

Hypothesis	Index/F-statistics				
	SP500	SP400	SPTRAN	SPUTIL	SPFIN
D1EM = D2EM = D3EM = 0	1.23 (0.30)	1.24 (0.29)	1.33 (0.26)	1.08 (0.36)	1.41 (0.24)
D1EM = D2EM = D3EM	0.19 (0.83)	0.17 (0.84)	1.20 (0.30)	0.16 (0.85)	0.46 (0.63)
D1UM = D2UM = D3UM = 0	8.04 (0.00)	7.31 (0.00)	3.40 (0.02)	17.81 (0.00)	8.96 (0.00)
D1UM = D2UM = D3UM	0.08 (0.92)	0.03 (0.97)	0.68 (0.51)	2.48 (0.08)	0.88 (0.42)
D1DR = D2DR = D3DR = 0	3.68 (0.01)	3.81 (0.01)	2.00 (0.11)	1.24 (0.29)	1.97 (0.11)
D1DR = D2DR = D3DR	5.15 (0.01)	5.47 (0.00)	2.97 (0.05)	1.03 (0.36)	2.78 (0.06)

NOTE: Marginal significance levels are reported in parentheses. Variable definitions are found in table 1.

money reliably influence the behavior of stock prices and that there appears to be no statistically significant change in this response across the different monetary policy regimes.[19]

The general hypothesis about discount rate changes on stock prices does not fare so well as the hypothesis about the effects of unanticipated changes in M1. Discount rate changes generally had a positive but not statistically significant (5 percent level) effect on stock prices before October 1979 and after October 1982. This result does not support the view that discount rate increases should negatively influence stock prices. It does, however, support the notion that, during periods in which monetary policy emphasizes the behavior of the federal funds rate, the discount rate may not impart relevant policy information not already contained in, for example, the federal funds rate.[20]

The results for the October 1979 to October 1982 period indicate that changes in the discount rate result in stock price movements generally consistent with the hypothesis described above. Changes in the discount rate have a significant (one-tailed) negative effect on all indexes during this period, except for the SPTRAN index. The size of the estimated coefficients, however, is lower for the more narrowly defined indexes than it is for the broad SP500 and SP400 measures. Thus, a 100 basis-point increase in the discount rate during this period led to a 60 basis-point decline in the growth rate of SP500 and SP400, but only a 28 basis-point drop in the growth rate of the SPUTIL index.

Why are the effects of discount rate changes so different across the different policy regimes? Prior to October 1979, movements in the federal funds rate directly conveyed information about changes in policy objectives, thus making the informational content of discount rate changes redundant.[21] A similar argument can be made about the post-October 1982 period, since the switch from a nonborrowed to a borrowed reserves targeting procedure is similar to a policy that smooths movements in the federal funds rate.[22] The finding that the estimated coefficients on

[19]This evidence is in sharp contrast to the results from studies examining the interest-rate/money relationship over this period.

[20]It should be noted that the discount rate changes during the pre-October 1979 period are positive and significant at the 10 percent level for all of the indexes except SPUTIL. For a possible explanation of this result, see the shaded insert on page 8.

[21]The evidence in the shaded insert on page 8 and accounts of discount rate changes in the *Wall Street Journal* do not support the gross generality of this view.

[22]If a borrowings target (referred to as the borrowings assumption) is used and the primary determinant of discount window borrowing is the federal-funds-rate/discount-rate spread, increases in the funds rate, ceteris paribus, necessitate an increase in reserves since borrowings will otherwise increase. Thus, reserves are injected, the funds rate falls and borrowings return to their desired level. This policy scenario suggests that movements of the federal funds rate after October 1982 again directly reflect policy objectives. For a more complete discussion, see Gilbert.

discount rate changes are insignificantly different from zero during the two different policy regimes suggests that the market's perception of changes in the discount rate may not be any different after October 1982 than it was before October 1979.

The test results in table 2 indicate that the discount rate change is an important variable in explaining the behavior of the broad indexes, but is less so for the more specialized groups. In fact, the reported F-statistic for the SPUTIL index indicates that we cannot reject the hypothesis that changes in the discount rate together have no significant effect. The test results also reveal that the effect of discount rate changes is not equal across regimes at reasonable levels of significance (except for SPUTIL).

Finally, the estimated coefficient on the discount rate surcharge (DRS) is highly significant and negative for each of the stock price indexes tested. The magnitude of the effect on the broad stock price measures is similar to that found by Pearce and Roley (1985); in addition, all of the stock price measures are affected. In fact, unlike the results for the discount rate, which tend to have a smaller effect on the narrower indexes, a change in the surcharge rate actually had a larger impact on the narrow indexes.

To summarize, the hypothesis that only unanticipated changes in money negatively influence the movement of stock prices cannot be rejected. This finding, which holds for most of the stock price indexes used and time periods tested, supports the efficient markets hypothesis, rejects the money demand hypothesis and corroborates earlier results based solely on the use of broad stock price indexes. It also shows that the effect of discount rate changes varies among the particular indexes and over the periods tested. Thus, although policy regime changes do not appear to influence the market's reaction to unanticipated changes in money, the evidence suggests that the information conveyed through discount rate changes varies across policy regimes.

Symmetry Hypothesis Tests

Analysts generally assume that positive and negative unanticipated changes in money have symmetrical influences on stock prices.[23] To test this hypothesis, we again use zero-one dummy variables to generate the appropriate interaction terms that differentiate positive and negative observations of UM.

Table 3 presents the results of this test. Positive values of UM are denoted by UM (+); negative values by UM (−).[24] Negative unexpected changes in money have no statistically significant effect on stock prices using the SP500, SP400 and the SPTRAN indexes. In each case, the reported t-values are quite small, as are the estimated coefficients. In tests of the equality of the coefficients on the positive and negative values of UM, we find that, for these three stock price measures, the t-statistics are large enough to reject equality at the 5 percent level. It appears that only positive values of UM have significant effects on changes in these stock prices; the growth rates of these indexes fell by 16 basis points for a $1 billion surprise in M1. This result suggests that market efficiency is violated.[25]

The SPUTIL and SPFIN results indicate that both positive and negative values of UM have similar, statistically significant effects on the stock price changes. In these instances, the calculated t-statistics to test coefficient equality are well below any acceptable level of significance. The symmetrical response of utility and financial stocks to an unanticipated increase or decrease in the money stock indicates that these stocks are relatively more sensitive to interest rate and price level movements than other stocks.

SUMMARY

The results of this study generally support the efficient markets hypothesis. Based on evidence from several different stock price indexes, unanticipated changes in money have a statistically significant effect on stock prices. Expected changes in money never display a statistically significant effect. The estimated effect of unanticipated changes in money did not differ across alternative monetary policy regimes. One

[23]Little research into the symmetry of the effects is available. Although Pearce and Roley (1983) and Roley and Troll (1983) test for the effects on interest rates when money changes are above or below stated policy targets, this does not directly address the hypothesis. Also, Pearce and Roley (1983) present similar tests for stock prices.

[24]Values of zero are included in the UM (+) data. Discount rate variables are omitted from the SPUTIL equation, because the evidence in table 2 indicates that they are not significant (jointly) at any reasonable level. It should be noted that reestimation of the equations in table 3 using a seemingly unrelated regression procedure does not alter the conclusions reached in this section.

[25]Gikas Hardouvelis, in private correspondence, suggests the following scenario. Consider the median forecaster facing the money announcement with equal probability that the announced M1 figure will be above or below the forecast. Given the results in table 3, the strategy is to sell before the announcement, since a positive surprise in money will lower stock prices while a negative surprise has no statistical effect. If such response persists, market efficiency is violated.

Table 3
Results for Symmetry Test

	Index				
Variable	SP500	SP400	SPTRAN	SPUTIL	SPFIN
Constant	0.048	0.049	0.067	0.024	0.040
	(2.18)	(2.16)	(1.90)	(1.20)	(1.32)
UM(+)	−0.162	−0.164	−0.166	−0.120	−0.153
	(5.07)	(4.93)	(4.01)	(5.75)	(4.56)
UM(−)	−0.046	−0.041	0.006	−0.086	−0.072
	(1.24)	(1.08)	(0.13)	(3.65)	(1.89)
D1DR	0.937	1.059	1.195		0.955
	(1.81)	(1.96)	(1.77)		(1.74)
D2DR	−0.604	−0.607	−0.340		−0.446
	(2.39)	(2.30)	(1.03)		(1.66)
D3DR	1.232	1.341	1.432		0.394
	(1.57)	(1.64)	(1.40)		(0.47)
DRS	−0.403	−0.391	−0.467	−0.551	−0.637
	(2.49)	(2.32)	(2.21)	(5.22)	(3.71)
t	2.48*	2.52*	2.75*	1.07	1.58
$\bar{R}^2$	0.022	0.021	0.015	0.039	0.025
SE	0.876	0.912	1.164	0.597	0.952
DW	1.79	1.82	2.00	1.98	2.01
ρ	—	—	0.19	0.27	0.23
			(8.38)	(11.73)	(9.94)

NOTE: The reported t-statistic is based on testing the hypothesis that UM (+) = UM (−). An asterisk denotes significance at 5 percent level. All other terms are defined in table 1.

result that does not support the efficient markets hypothesis is the finding that the effects of unanticipated money changes are asymmetric: only positive values of unanticipated changes in money appear to have a significant impact on the SP500, SP400 and SPTRAN measures.

The effects of discount rate changes on stock prices vary with changes in monetary policy procedures; their influence also lessened as the stock price index became narrower. In general, discount rate changes have significant negative effects on stock prices only from October 1979 to October 1982, a period characterized by a monetary policy that focused on controlling nonborrowed reserves. Before and after that period, discount rate changes convey little additional information about policy.

REFERENCES

Batten, Dallas S., and Daniel L. Thornton. "The Discount Rate, Interest Rates and Foreign Exchange Rates: An Analysis with Daily Data," this *Review* (February 1985), pp. 22–30.

Branch, Ben. "Common Stock Performance and Inflation: An International Comparison," *Journal of Business* (January 1974), pp. 48–52.

Coate, D., and James VanderHoff. "Stock Returns, Inflation and Real Output," unpublished manuscript, Rutgers University (January 1985), forthcoming *Economic Inquiry*.

Cohn, Richard A., and Donald R. Lessard. "The Effect of Inflation on Stock Prices: International Evidence," *Journal of Finance* (May 1981), pp. 277–89.

Cornell, Bradford. "The Money Supply Announcements Puzzle: Review and Interpretation," *American Economic Review* (September 1983), pp. 644–57.

Davidson, Lawrence S., and Richard T. Froyen. "Monetary Policy and Stock Returns: Are Stock Markets Efficient?" this *Review* (March 1982), pp. 3–12.

Falk, Barry, and Peter F. Orazem. "The Money Supply Announcements Puzzle: Comment," *American Economic Review* (June 1985), pp. 562–64.

Fama, Eugene F., Lawrence Fisher, Michael C. Jensen and Richard Roll. "The Adjustment of Stock Prices to New Information," *International Economic Review* (February 1969), pp. 1–21.

Fama, Eugene F., and G. William Schwert. "Asset Returns and Inflation," *Journal of Financial Economics* (November 1977), pp. 115–46.

Fama, Eugene F. "Stock Returns, Real Activity, Inflation, and Money," *American Economic Review* (September 1981), pp. 545–65.

Feldstein, Martin. "Inflation and the Stock Market," *American Economic Review* (December 1980), pp. 839–47.

French, Kenneth R. "Stock Returns and the Weekend Effect," *Journal of Financial Economics* (March 1980), pp. 55–69.

Gibbons, Michael R., and Patrick Hess. "Day of the Week Effects and Asset Returns," *Journal of Business* (October 1981), pp. 579–96.

Gilbert, R. Alton. "Operating Procedures for Conducting Monetary Policy," this *Review* (February 1985), pp. 13–21.

Gultekin, N. Bulent. "Stock Market Returns and Inflation Forecasts," *Journal of Finance* (June 1983), pp. 663–73.

Hardouvelis, Gikas A. "Macroeconomic Information and Stock Prices," unpublished manuscript, Columbia University (September 1985).

Hasbrouck, Joel. "Stock Returns, Inflation, and Economic Activity: The Survey Evidence," *Journal of Finance* (December 1984), pp. 1293–310.

Hein, Scott E. "The Response of Short-Term Interest Rates to Weekly Money Announcements: Comment," *Journal of Money, Credit and Banking* (May 1985), pp. 264–71.

Kessel, Reuben A., and Armen A. Alchian. "Effects of Inflation," *Journal of Political Economy* (December 1962), pp. 521–37.

King, Benjamin F. "Market and Industry Factors in Stock Price Behavior," *Journal of Business* (January 1966), pp. 139–90.

Kool, Clemens J.M., and R. W. Hafer. "Inflation and Stock Prices: A Long Term View," Federal Reserve Bank of St. Louis Working Paper No. 86-001 (January 1986).

Lloyd-Davies, P., and Michael Canes. "Stock Prices and the Publication of Second-Hand Information," *Journal of Business* (January 1978), pp. 43–56.

Niederhoffer, Victor. "The Analysis of World Events and Stock Prices," *Journal of Business* (April 1971), pp. 193–219.

Nelson, Charles R. "Inflation and Rates of Return on Common Stocks," *Journal of Finance* (May 1976), pp. 471–82.

Pearce, Douglas K. "An Empirical Analysis of Expected Stock Price Movements," *Journal of Money, Credit and Banking* (August 1984), pp. 317–27.

Pearce, Douglas K., and V. Vance Roley. "The Reaction of Stock Prices to Unanticipated Changes in Money: A Note," *Journal of Finance* (September 1983), pp. 1323–33.

________ . "Stock Prices and Economic News," *Journal of Business* (January 1985), pp. 49–67.

Roley, V. Vance, and Rick Troll. "The Impact of New Economic Information on the Volatility of Short-Term Interest Rates," Federal Reserve Bank of Kansas City *Economic Review* (February 1983), pp. 3–15.

________ . "The Impact of Discount Rate Changes on Market Interest Rates," Federal Reserve Bank of Kansas City *Economic Review* (January 1984), pp. 27–39.

Rozeff, M. S. "Money and Stock Prices: Market Efficiency and the Lag in Effect of Monetary Policy," *Journal of Financial Economics* (September 1974), pp. 245–302.

Santoni, G. J. "The Effects of Inflation on Commercial Bank Stock Prices," this *Review* (forthcoming 1986).

Schwert, G. William. "The Adjustment of Stock Prices to Information About Inflation," *Journal of Finance* (March 1981), pp. 15–29.

Sheehan, Richard G. "Weekly Money Announcements: New Information and Its Effects," this *Review* (August/September 1985), pp. 25–34.

Smirlock, Michael, and Jess Yawitz. "Asset Returns, Discount Rate Changes, and Market Efficiency," *Journal of Finance* (September 1985), pp. 1141–58.

Sprinkel, Beryl W. *Money and Stock Prices* (Richard D. Irwin, Inc., 1964).

Sorensen, Eric H. "Rational Expectations and the Impact of Money upon Stock Prices," *Journal of Financial and Quantitative Analysis* (December 1982), pp. 649–62.

Wallich, Henry C. "Recent Techniques of Monetary Policy," Federal Reserve Bank of Kansas City *Economic Review* (May 1984), pp. 21–30.

APPENDIX
Data Definitions

Money

The expected change in the money supply (EM) is the median forecast obtained from Money Market Services, Inc. (MMS).

Since 1977 this firm has conducted a weekly telephone survey of 50 to 60 government securities dealers to obtain their forecast of the change in M1. Before February 8, 1980, the survey was conducted twice each week, initially on Tuesday, with a follow-up call on Thursday, allowing respondents to alter their original guess. From February 1980 through February 1984, however, the survey was conducted only on Tuesday, because of the Federal Reserve's shift in announcing the weekly M1 figures from Thursday to Friday afternoon. Beginning February 1984, which corresponds to the change from lagged to contemporaneous reserve accounting and with the announcement day again being changed from Friday to Thursday afternoon, MMS once again used two surveys: the initial poll on the Friday immediately following the Thursday money announcement and again on the following Tuesday. For this study, we use the forecasts from the Tuesday survey. The data used here are those from Pearce and Roley (1985) as updated by Doug Pearce. We would like to thank him for making these as well as the actual M1 data available.

Actual changes in weekly M1, which appear in the Federal Reserve's H.6 statistical release, are measured as the first announced value minus the first revised estimate of the previous week's level. Due to the changing definition of M1 during our sample, the following procedure was followed to obtain a series consistent with that being forecast by the survey respondents: Until February 1980, we use the old definition of M1. From February 1980 through November 1981, we use the actual M1B measure (not the M1B value that was "shift-adjusted" for the introduction of NOW accounts). Finally, from November 1981 through the end of our sample, we use the current definition of M1. Given the actual and expected series for money, unanticipated changes in M1 (UM) are measured as actual less expected.

Stock Prices

The stock price indexes used in this study are daily close values of the broad Standard and Poor's (SP) 500 and 400 indexes, as well as the industry-specific indexes for transportation (SPTRAN), utilities (SPUTIL) and financial institutions (SPFIN). In each instance, the stock price change is measured as the difference of the logarithms.

Discount Rate

Changes in the Federal Reserve's discount rate and the surcharge are measured in percentage points; that is, a 100 basis-point change in either rate is measured as 1.0. Our measurement of the discount rate change, unlike that in some studies, follows the Federal Reserve's official dating procedure, changing when one of the 12 Federal Reserve Banks has the approval of the Federal Reserve Board to change its rate. The data used here is based on the day the new rate is in effect, not when the new rate is announced in the financial press.

The Effects of Inflation on Commercial Banks

G. J. Santoni

PEOPLE disagree about the effect of the recent decline in inflation on U.S. financial institutions. Some claim that the "sudden drop in inflation . . . put the country's whole credit structure under great strains that are becoming increasingly apparent."[1] One of the more important indicators of the "strain," according to this argument, is the increase in bank failures.[2] Others argue that financial institutions have been the "beneficiaries of disinflation and falling interest rates," pointing out that commercial bank earnings increased as the inflation rate fell.[3]

This article discusses the effect of inflation on commercial banks by analyzing the relationship between inflation and the market value of bank capital.

INFLATION: A BRIEF EXPLANATION

Inflation is an increase in the general price level, and is typically expressed as an annual percentage rate of change. For example, the GNP deflator (one index of the general price level) rose from 1.00 in 1982 to 1.038 in 1983, then increased to 1.081 in 1984. Inflation averaged 3.8 percent during 1982–83 and about 4.1 percent during 1983–84. The average annual rate over the two-year interval was about 3.9 percent.[4]

Inflation depreciates the value of money. An inflation rate of 4.0 percent means that the dollar falls in value at an annual rate of 4.0 percent in terms of the goods it will buy.

BANKS AND NOMINAL FINANCIAL INSTRUMENTS

Inflation is important for banks because they typically deal in *nominal* financial instruments, that is, instruments denominated in fixed dollar amounts. For example, when a bank makes a loan, it accepts nominal financial instruments (notes, mortgages, commercial paper and other financial securities) as evidence of the debtor's obligation to the bank. When a bank borrows, it issues nominal financial instruments to creditors (deposit liabilities, acceptances and debentures) as evidence of its obligation.

An Important Characteristic

While nominal financial instruments differ from one another in many respects, they share one important characteristic: their payments are fixed in nominal value, that is, in terms of dollars. Nominal instruments make up the bulk of bank assets and liabilities. Furthermore, banks are typically net creditors in nominal instruments because their nominal assets exceed their nominal liabilities (see appendix 1 for a theoretical explanation).[5]

G. J. Santoni is a senior economist at the Federal Reserve Bank of St. Louis. *Thomas A. Pollmann provided research assistance.*

[1]See Shaky Credit Structure (1985).

[2]*Ibid.*

[3]See Corporate Earnings Uneven (1985).

[4]There are various methods of computing average annual rates of change. The method employed in this paper assumes continuous compounding. The rates are calculated by dividing the difference between the natural logarithms of the price level at the two points in time by the number of intervening years and multiplying by 100.

[5]See Alchian and Kessel (1977a) and Kessel (1956). Of course, banks have real assets and liabilities as well (land, buildings, office equipment, equities, etc.). These, however, make up a very small portion of bank portfolios and are irrelevant in assessing the effect of inflation on banks.

Some Balance Sheet Data

Table 1 uses data from the consolidated balance sheet of domestically chartered commercial banks to illustrate their net position in nominal instruments.[6] Nominal assets are calculated by subtracting the values of bank premises, other real estate owned, the equities of other firms owned, and investment in subsidiaries from total assets. These items are subtracted because the market prices of real assets vary directly with the price level. Nominal liabilities are the sum of total deposits, subordinated notes and debentures, federal funds purchased, interest-bearing demand notes, mortgage indebtedness, all other liabilities for borrowed money and the value of preferred stock. Preferred stock, which is similar to a bond, is included as a nominal liability because it is an obligation of the bank to pay a fixed stream of dollars.

The table 1 data indicate that, in the aggregate, the nominal assets of these banks exceed their nominal liabilities. The excess of nominal assets over nominal liabilities amounts to 66.3 percent of bank capital.[7]

Table 1

Net Nominal Assets of All Commercial Banks (in billions of dollars)

Nominal assets = total assets − real assets		
Total assets		$2,681.0
Less real assets:		
Equity ownership in other firms	$10.7	
Bank premises	39.7	
Investment in subsidiaries	1.9	
Real estate other than premises	6.9	59.2
Nominal assets		$2,621.8
Nominal liabilities[1] = total liabilities + preferred stock		
Total liabilities		$2,504.5
Preferred stock		1.0
Nominal liabilities		$2,505.5
Net nominal assets = nominal assets − nominal liabilities		
Nominal assets		$2,621.8
Nominal liabilities		2,505.5
Net nominal assets		$ 116.3
Net nominal assets as a percent of equity		66.3%

NOTE: Data are as of third quarter 1985.
[1]All bank liabilities are nominal.
SOURCE: Board of Governors of the Federal Reserve System

ANTICIPATED INFLATION AND BANKS

An increase in anticipated inflation raises the nominal interest rate. This increases the number of dollars that creditors or debtors who are transacting in nominal financial instruments expect to receive or pay when loans mature (see shaded insert). If these expectations are realized, all nominal values will be higher at maturity. Table 2 shows this effect on the balance sheet of a hypothetical bank. The example assumes that all of the bank's borrowing and lending contracts were negotiated with the expectation that the rate of inflation over the next two years would be 5.0 percent. The bank's loan contracts have a two-year life. Its borrowing contracts mature at the end of each year and are renegotiated at the existing interest rate. Reserve requirements against all deposits are 10.0 percent.

For simplicity, the real interest rate is assumed to be zero so the nominal interest rate on bank loans is 5.0 percent.[8] The interest rate on bank deposits is 4.5 percent. The spread between the bank's borrowing and lending rates is necessary compensation for the requirement to hold non-interest-earning reserves (see appendix 1). All assets and liabilities are valued at market prices so assets minus liabilities, or capital, represents the market value of the bank, $200, in this example. The general level of prices is 1.0 in panel A.

Panel B shows the balance sheet of the bank at the end of the first year assuming that the anticipated inflation is realized and that nothing else has occurred to change the account balances. Accrued interest on deposit liabilities is $45, while $50 interest has accrued on bank loans. A portion of the bank's interest earnings ($4.50) must be added to reserves to cover the increase in deposits. The nominal value of bank capital has increased to $210.00, but its real value is unchanged ($200.00).

A similar result occurs in panel C, which shows the balance sheet at the end of the second year. The anticipated inflation has no real effect on the bank's capital and, therefore, on the wealth of its stockholders.

[6]This calculation should be considered as illustrative only, since book values rather than market values are used.

[7]As above, capital excludes outstanding preferred stock.

[8]The assumption about the real rate has no qualitative effect on the results. See appendix 1.

Forecasting Inflation

Anticipated and Unanticipated Inflation

Many economic transactions require a commitment to exchange money at some future time. Credit transactions are a good example of this. Since inflation reduces the future value of money, it pays people (both potential borrowers and lenders) to try to forecast inflation over the relevant time period. This forecast is called *anticipated* inflation.[1] As the name suggests, anticipated inflation is forward-looking. It is the rate of change in the general price level that people think will occur during some specific future time period.

Of course, the accuracy of inflation forecasts depends on future events and circumstances that are unknown when the forecast is made. Consequently, these forecasts generally will be "wrong."[2] Any difference between actual (or realized) inflation and anticipated inflation is called *unanticipated* inflation. Unanticipated inflation is known only with hindsight. Because it is known only after the fact, it plays no role in people's decisions. It is important, however, in assessing whether the decisions produced profits or losses.

[1]See Alchian and Allen (1977), p. 490. They note that "though odd names are given to inflation (creeping, galloping, runaway, and hyper-), a critical distinction is between *unanticipated* and *anticipated* inflation."

[2]Economic theory suggests that, although "wrong," the forecasts will not consistently over- or underpredict; that is, forecasts will be unbiased. See Fisher (1954), pp. 36-37; Fisher (1907), p. 213; and Fama (1970) for discussions of business foresight and efficient markets.

Anticipated Inflation and Interest Rates

The nominal interest rates quoted in financial markets are formed in the process of contracting between borrowers and lenders. They indicate the number of dollars the borrower must pay to the creditor in the future in exchange for a given number of present dollars. If borrowers and lenders expect the value of the dollar to depreciate in terms of the goods it will buy over the life of the loan (i.e., if they anticipate inflation), the nominal interest rate specified in the loan contract will take account of this. The interest rate will be sufficiently high to compensate for the expected depreciation in the value of the dollar.[3]

To illustrate, suppose the real interest rate is 3 percent and the anticipated rate of inflation over the coming year is 5 percent. People think that it will take $1.05 one year from now to purchase the goods that $1.00 will buy today. A loan of $1,000 for one year will require a payment of $1,081.50 (= $1,000.00 × 1.03 × 1.05) at maturity. This implies a nominal interest rate of 8.15 percent.[4] The anticipated real value of this amount at maturity is $1,030 (= $1,081.50/1.05), which is the sum of the principal ($1,000) and the real return ($30).

[3]See Fisher (1965), pp. 1-100, who relates the nominal interest rate, i, to the *ex ante* real interest rate, r, and the anticipated rate of inflation, π^*, as follows:

$$i = r + \pi^* + (r)(\pi^*).$$

Fisher's hypothesis regarding the formation of the nominal interest rate is an approximation to the "true" relationship; it ignores risk premiums and the effect of taxes on interest income and assumes that the anticipated rate of inflation is held with certainty. See Darby (1975) and Kochin (1981). The *ex ante* real rate is the premium in terms of real goods that creditors expect to receive (and borrowers expect to pay) expressed as a percentage of the principal of the loan. See Fisher (1954) and Santoni and Stone (1981) for discussions of the real rate of interest.

[4]8.15 = [($1,081.50/$1,000.00) – 1]100.

UNANTICIPATED INFLATION AND BANKS

If the realized rate of inflation exceeds the anticipated rate, the price level has risen unexpectedly. The unexpected increase in the price level causes a proportional reduction in the exchange value of both nominal financial assets and liabilities in terms of real goods. Because banks are typically net creditors in nominal instruments, bank owners lose wealth when there is unanticipated inflation (that is, when bank capital declines).[9]

Table 3 presents a numerical example of this effect. The assumptions in table 3 are the same as those in table 2 except that people are surprised by a 10 percent increase in the price level in the first year. The example assumes that the surprise is interpreted as a

[9]See Keynes (1923), pp. 18–19, and Alchian and Kessel (1977b).

Table 2

The Effect of an Anticipated Inflation of 5.0 Percent

Panel A: The current balance sheet. The price level is 1.0.

Assets:		Liabilities:	
Reserves	$ 100.00	Deposits	$1,000.00
Loans and securities	1,000.00	Capital:	200.00
Premises	100.00		$1,200.00
	$1,200.00		

Panel B: The balance sheet one year hence. The price level is 1.05.

Assets:		Liabilities:	
Reserves	$ 104.50	Deposits	$1,045.00
Loans and securities	1,045.50	Capital:	210.00
Premises	105.00		$1,255.00
	$1,255.00		

Real value of capital = $210/1.05 = $200

Panel C: The balance sheet two years hence. The price level is 1.1025.

Assets:		Liabilities:	
Reserves	$ 109.20	Deposits	$1,092.02
Loans and securities	1,093.07	Capital:	220.50
Premises	110.25		$1,312.52
	$1,312.52		

Real value of capital = $220.5/1.1025 = $200

one-time-only deviation in the price level so that the inflation forecast for the second year remains at 5.0 percent.

Panel B shows the effect of the unanticipated inflation. The bank's nominal assets and liabilities are unaffected by the inflationary surprise. The increase in these dollar values is fixed by contract. In contrast, the nominal value of the bank's real assets, the premises, increases by the realized rate of inflation, 10.0 percent. The nominal value of capital increases from $200 to $215. The value of the bank in terms of the real goods for which it can be exchanged, however, declines to $195.45. The unanticipated inflation causes the real value of the bank to fall by $4.55.[10]

Panel C shows the bank's balance sheet at the end of the second year. The real value of the bank remains at $195.45, indicating that the one-time inflationary surprise produces a permanent reduction in the real value of the bank even though the rate of inflation in subsequent years returns to 5.0 percent.

THE INTEREST RATE AND INFLATION

A bank's nominal financial assets and liabilities typically mature at different dates. At any given moment, the maturity dates of a bank's assets generally extend beyond those of its liabilities.[11] In other words, an

[10]An unanticipated decrease in the price level produces symmetrical results in that the real wealth of bank owners is increased.

[11]More precisely, the duration of the bank's receipt stream exceeds the duration of its payment stream. For discussions of duration, see Samuelson (1945), p. 19; Bierwag, Kaufman and Toevs (1983); Maisel and Jacobson (1978); and Santoni (1984).

Table 3
The Effect of an Unanticipated Inflation

Panel A: The current balance sheet. The price level is 1.0.

Assets:		Liabilities:	
Reserves	$ 100.00	Deposits	$1,000.00
Loans and securities	1,000.00	Capital:	200.00
Premises	100.00		$1,200.00
	$1,200.00		

Nominal assets − nominal liabilities = ($100 + $1,000) − $1,000 = $100

Real value of capital = $200/1.0 = $200

Panel B: The balance sheet one year hence. The price level is 1.10.

Assets:		Liabilities:	
Reserves	$ 104.50	Deposits	$1,045.00
Loans and securities	1,045.50	Capital:	215.00
Premises	110.00		$1,260.00
	$1,260.00		

Real value of capital = $215/1.10 = $195.45

Panel C: The balance sheet two years hence. The price level is 1.155.

Assets:		Liabilities:	
Reserves	$ 109.20	Deposits	$1,092.02
Loans and securities	1,093.07	Capital:	225.75
Premises	115.50		$1,317.77
	$1,317.77		

Real value of capital = $225.75/1.155 = $195.45

interest rate change affects the payment stream obligated by the bank's liabilities before it affects the bank's receipt stream. Consequently, an increase in the interest rate reduces the expected net stream of dollar receipts as the bank's creditors renegotiate for the higher interest rate, while the interest rate earned by the bank on its existing loans is locked up. Of course, the loans eventually mature and are renegotiated at the higher nominal rate, but the bank's capital is reduced nonetheless.

An Illustration

Table 4 illustrates the effect of a change in the nominal interest rate on bank capital. The example assumes the interest rate increases because anticipated inflation increases. The qualitative effect illustrated by the example, however, results from the change in the interest rate, regardless of what produced the change.

In this example, anticipated inflation at the time the bank initially contracts with its creditors and debtors is 5.0 percent. The bank's contracts with its creditors mature in one year, while its loans mature at the end of the second year and cannot be renegotiated before maturity.

As in the previous examples, the bank's loans and

Table 4

The Effect of a Change in Anticipated Inflation

Panel A: The current balance sheet. The price level is 1.0.

Assets:		Liabilities:	
Reserves	$ 100.00	Deposits	$1,000.00
Loans and securities	1,000.00	Capital:	200.00
Premises	100.00		$1,200.00
	$1,200.00		

Panel B: The balance sheet one year hence. The price level is 1.05.

Assets:		Liabilities:	
Reserves	$ 104.50	Deposits	$1,045.00
Loans and securities	1,045.50	Capital:	210.00
Premises	105.00		$1,255.00
	$1,255.00		

Real value of capital = $210.00/1.05 = $200.00

Panel C: The balance sheet two years hence. The price level is 1.155.

Assets:		Liabilities:	
Reserves	$ 113.90	Deposits	$1,139.05
Loans and securities	1,090.65	Capital:	181.00
Premises	115.50		$1,320.05
	$1,320.05		

Real value of capital = $181.00/1.155 = $156.71

deposits are $1,000. The lending rate is 5.0 percent, and the borrowing rate is 4.5 percent. Panel A shows the bank's initial balance sheet. Panel B shows the balance sheet at the end of the first year assuming that the realized rate of inflation during the first year was 5.0 percent, the same as the anticipated rate.

Panel C shows the balance sheet at the end of the second year assuming that the anticipated rate of inflation was revised upward to 10.0 percent at the beginning of the second year, just before the bank renegotiated its contracts with depositors. The example assumes that the realized rate of inflation during the second year matches the anticipated rate.

The increase in anticipated inflation causes the nominal interest rate to rise to 10.0 percent during the second year, while the interest rate on bank deposits increases to 9.0 percent. At the end of the second year, these deposits will amount to $1,139.05 (= $1,045.00 × 1.09). The bank, however, is prevented from raising the interest rate on its existing loans (= $1,000) by the terms of its contract. These loans continue to yield 5.0 percent in the second year, accruing earnings of $50.00 during the year. Of course, the bank can make new loans of $45.50 at the beginning of the second year. These new loans, which result from the net interest earnings the bank obtained the first year, are made at the higher interest rate (10.0 percent) and accrue earnings of $4.55 (= $45.50 × .10) at year-end.

Since bank deposits increased during the second year, some of the bank's interest earnings must be used to increase reserves. The increase in bank deposits amounts to $94.05 (= $1,139.05 − $1,045.00), so reserves must increase to \$113.90 or by \$9.40 (= \$94.05 × .10). As a result, the bank's loan account at year-end is \$1,090.65 (= \$1,000.00 + \$50.00 + \$45.50 + \$4.55 − \$9.40). Bank premises increase in nominal value by the realized rate of inflation and amount to \$115.50 (= \$105.00 × 1.10) at year-end. Note that both the nominal and real value of capital decline. The real value of capital falls by \$43.29 to \$156.71 (= \$181.00/1.155).

As the table 4 example shows, a change in the interest rate can have a fairly substantial effect on the bank when the maturities of the bank's assets and liabilities differ. In this particular example, the real value of capital declined by about 22.0 percent when the interest rate doubled.

An increase in anticipated inflation affects banks in a way that is qualitatively the same as unanticipated inflation. This is because the upward revision in anticipated inflation that occurs at the end of the first year was not forecast at the beginning of the year. If people had anticipated inflation of 5.0 percent the first year and 10.0 percent the second year, the rate of interest on two-year loans would not have been 5.0 percent. Rather, it would have been higher to reflect the fact that anticipated inflation averages 7.2 percent across the two years. Unanticipated inflation and changes in anticipated inflation have similar effects because both reflect a misguess about inflation.

To recap the main points so far, the previous discussion suggests that inflation affects the real capital value of banks through two channels. First, capital value falls when the actual rate of inflation exceeds the anticipated rate. This is called unanticipated inflation. Second, capital value falls when the anticipated rate of inflation is revised upward, because this causes nominal interest rates to rise unexpectedly. The reverse occurs if the actual rate of inflation falls short of the anticipated rate or if the anticipated rate of inflation is revised downward.

SOME ESTIMATES

These implications can be examined by observing the effect of inflation on various indexes of the stock prices of publicly traded banks. Stock prices are used as a proxy for the capital value of banks because they represent the market's assessment of the present value of the future net receipts banks are expected to generate.

The relationship between changes in the real stock prices of banks and the other variables is assumed to take the form shown in equation 1:

$$(1)\quad \Delta Ln(V/P)_t = C + \alpha\Delta Lny_t + \beta\Delta Ln(i-\pi^*)_t + \gamma\pi^u_t + \delta\pi^* + \varepsilon\Delta L\eta\pi^*,$$

where

V/P = the real price of bank stock,
C = a constant,
y = real income,
$(i-\pi^*)$ = the nominal interest rate less anticipated inflation,
π^u = unanticipated inflation, which is the difference between realized inflation, π, and anticipated inflation, π^*. $\pi^u \gtreqless 0$.

Equation 1 expresses real stock prices, real income, the interest rate residual and the change in anticipated inflation in terms of annualized percentage changes. The unanticipated rate of inflation is the difference between two annualized percentage rates of change: the realized rate of inflation and the anticipated rate. The estimates use quarterly data from the first quarter of 1962 through the fourth quarter of 1984.

Anticipated and Unanticipated Inflation

Measuring anticipated inflation is a problem. Since we only observe actual inflation, various analysts have used different methods to estimate anticipated inflation.[12]

This study estimates anticipated inflation one quarter ahead by employing a time-series forecast of inflation. This method generates predictions of inflation solely on the basis of its past behavior.[13] The difference between the actual rate of inflation and the rate forecast by the model is interpreted as the empirical counterpart of unanticipated inflation, π^u. Because the real price of bank stock is expected to be inversely related to unanticipated inflation, the coefficient of π^u should be negative.

Anticipated inflation, π^*, and changes in the real price of bank stock are theoretically unrelated; consequently, the coefficient of this variable should be zero. Changes in anticipated inflation change interest rates,

[12]See Hafer and Hein (1985).

[13]Roughly, the technique accounts for the past pattern of inflation by estimating a model that provides a description of the process that generated the observed series. Past observations of inflation are then used along with the information contained in the time-series model to forecast inflation one period ahead. For further discussion of time-series models and their properties, see Pindyck and Rubinfeld (1981), pp. 469–573, especially pp. 469–70 and 493–97. For further discussion of the model employed here, see appendix 2.

however, and these interest rate changes are expected to be inversely related to changes in stock prices. Estimates of the changes in anticipated inflation are obtained directly from the inflation forecasts.[14]

The Business Cycle

Real income growth was included as an explanatory variable to control for the effect of the business cycle on bank earnings. Business expansions increase the real quantity of bank loans, securities and deposits, which is thought to have a positive impact on the expected earnings stream. The empirical counterpart of real income used in the regressions is gross national product (GNP) divided by the GNP deflator. The expected sign of the coefficient of this term is positive.

The Interest Rate

The prices of bank stocks are expected to be related to changes in the interest rate. The interest rate will vary with changes in the *ex ante* real interest rate, changes in income tax laws, changes in risk premiums and changes in anticipated inflation. Since the interest rate includes all of these factors, changes in it cannot be readily attributed to the effect of any one of them. The qualitative effect of a change in the interest rate on stock prices, however, is the same regardless of the source. The expected sign of the coefficient of interest rate changes is negative.

Since this paper focuses on the effect of inflation, the following estimates attempt to isolate the effect of a change in anticipated inflation. As mentioned above, an estimate of anticipated inflation, π^*, is produced by the time-series forecast of inflation. When this estimate is subtracted from the nominal interest rate, the residual is an estimate of the nominal interest rate excluding anticipated inflation. Consequently, changes in the estimate of anticipated inflation, $\Delta\pi^*$, and changes in the difference between the nominal rate and the estimate of anticipated inflation, $\Delta(i-\pi^*)$, can be included separately in the regression equation.[15] The expected sign of each of these terms is negative.

Controlling for Problem Loans

In addition to the above variables, the estimated equations include a dummy variable to control for the effect that recent Latin American loan problems have had on bank stock prices. During the early part of 1982, it became apparent that certain Latin American countries would have difficulty honoring their obligations to U.S. banks. In October and November 1982, the central bank of Brazil began borrowing heavily from the Exchange Stabilization Fund of the U.S. Treasury; Mexico began drawing heavily on its swap arrangement with the Federal Reserve System in April of the same year. News reports on the extent of the problem continued to surface for about three quarters. The period dummied begins in the first quarter of 1982 and extends through the third quarter of 1982, when it became evident that the U.S. government would take an active role in resolving the problem.[16] The expected sign of the dummy is negative.

The Estimates

Table 5 presents the regression results. Estimate 1 examines the effect of inflation on an index of the real share prices of banks located outside New York City. Estimate 2 does the same thing for New York City banks.[17]

The signs of the estimated coefficients are as expected. The estimates indicate that unanticipated inflation and changes in the anticipated rate of inflation are inversely related to changes in the real price of bank stock. As expected, the estimated coefficient of anticipated inflation is not significantly different from zero in a statistical sense.

---

[14]Changes in the interest rate are expected to be positively related to changes in anticipated inflation. To check this, changes in the Aaa bond rate, ΔR, and changes in the 3-month Treasury bill rate, ΔRS, were regressed on the estimate of the change in inflation expectations. The results are presented below.

$$\Delta R_t = .09 + .13\Delta\pi^*_t \qquad \Delta RS_t = .06 + .36\,\Delta\pi^*_t$$
$$(1.93)\quad(3.03)^* \qquad\qquad (.58)\quad(3.71)^*$$
$$DW = 1.65 \qquad DW = 1.79$$
$$R^2 = .10 \qquad R^2 = .14$$

Although both coefficients are less than one, they are both positive and significantly different from zero. The estimated coefficient of $\Delta\pi^*$ is larger in the equation for the short-term interest rate, which suggests that the inflation forecast used here is a better estimate of short-run expectations.

[15]Actually, the data entry is one plus the difference between the nominal rate and anticipated inflation. This is necessary because the difference is negative in some quarters during 1971, 1975 and 1976. See Brown and Santoni (1981) for a discussion of some problems associated with this method of separating the nominal rate into its various components.

[16]On February 2, 1983, the chairman of the Federal Reserve Board addressed the House Committee on Banking, Finance and Urban Affairs regarding the problem and measures to deal with it. See Volcker (1983).

[17]This was done because Standard and Poor's reports the data this way.

Table 5

Estimating the Effect of Inflation on the Price of Bank Shares, Sample Period: I/1962–IV/1985

Estimate 1:

$$\Delta LnBK/P = \underset{(.47)}{-4.29} + \underset{(2.21)^*}{1.79}\Delta Lny - \underset{(3.91)^*}{4.72}\Delta Ln(1+i-\pi^*) - \underset{(3.19)^*}{1.48}\pi^u + \underset{(.15)}{.05}\pi^* - \underset{(3.01)^*}{.12}\Delta Ln\pi^* - \underset{(2.64)^*}{11.75}\,DUM$$

RSQ = .34
DW = 1.68

Estimate 2:

$$\Delta LnBKNY/P = \underset{(.64)}{5.94} + \underset{(1.33)}{1.10}\Delta Lny - \underset{(4.44)^*}{5.51}\Delta Ln(1+i-\pi^*) - \underset{(2.81)^*}{1.34}\pi^u + \underset{(.99)}{.35}\pi^* - \underset{(2.97)^*}{.12}\Delta Ln\pi^* - \underset{(1.32)}{6.05}\,DUM$$

RSQ = .31
DW = 1.74

where:
BK/P = the Standard and Poor's index of the real share prices of banks located outside New York City
BKNY/P = the Standard and Poor's index of the real share prices of New York City banks
y = Real Gross National Product
i = the corporate Aaa bond rate
π^u = unanticipated inflation
π^* = anticipated inflation
DUM = 1 during I/1982–III/1982 and zero otherwise

NOTE: Absolute values of t-scores appear in parentheses. * = significantly different from zero at the 5 percent level.

The coefficient of the dummy variable has the expected sign in both estimates but is not significant in estimate 2. In the case of estimate 1, the coefficient is significant and its point estimate is fairly large, suggesting that the growth in real stock prices was about 12 percent lower, on average, during the first three quarters of 1982, other things the same. This may be somewhat misleading since the confidence interval for this coefficient ranges from −2.9 to −20.7.

Implications for Banks

The average forecast of inflation (π^*) generated by the time-series model during 1984 was about 4.0 percent. This fell to about 3.5 percent during 1985, resulting in a 13.5 percent drop in anticipated inflation ($\Delta Ln\pi^*$). The table 5 estimates suggest that this raised the real stock prices of the banks in the sample by about 1.6 percent (= −13.5 × −.12). In addition, the decline in the actual rate of inflation exceeded the decline in anticipated inflation. As a result, unanticipated inflation averaged about −.85 percent in 1985, raising the real stock prices of banks by an additional 1.2 percent (= −.85 × −1.4). In sum, the real stock prices of banks increased by about 3.0 percent, ceteris paribus, as a consequence of the fall in anticipated inflation in 1985 and because the actual rate of inflation in 1985 was even lower than anticipated.

CONCLUSION

This paper examines the effect that inflation has on the share prices of commercial banks. The results indicate that the real share prices of banks are inversely related to both unanticipated inflation — that is, deviations in the realized rate of inflation from its anticipated rate — and changes in anticipated inflation. Contrary to some claims, this evidence indicates that bank shareholders have benefited from the recent decline in the rate of inflation and that any unexpected resurgence of inflation would be harmful.

REFERENCES

Alchian, Armen A., and William R. Allen. *Exchange and Production: Competition, Coordination and Control,* 2nd ed. (Wadsworth Publishing Company, Inc., 1977), pp. 490–94.

Alchian, Armen A., and Reuben A. Kessel. "Effects of Inflation," *Economic Forces at Work* (Liberty Press, 1977a), pp. 363–96.

________ and ________ . "Redistribution of Wealth Through Inflation," *Economic Forces at Work* (Liberty Press, 1977b), pp. 397–412.

Bierwag, G. O., George G. Kaufman and Alden Toevs. "Duration: Its Development and Use in Bond Portfolio Management," *Financial Analysts Journal* (July/August 1983), pp. 15–35.

Brown, W. W., and G. J. Santoni. "Unreal Estimates of the Real Rate of Interest," this *Review* (January 1981), pp. 18–26.

"Corporate Earnings Uneven," *New York Times,* November 4, 1985.

Darby, Michael R. "The Financial and Tax Effects of Monetary Policy on Interest Rates," *Economic Inquiry* (June 1975), pp. 266–76.

Fama, Eugene F. "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance,* Papers and Proceedings (May 1970), pp. 383–417.

Fisher, Irving. *Appreciation and Interest* (Augustus M. Kelley, 1965), pp. 1–100.

________ . *The Theory of Interest* (Kelley and Millman, 1954).

________ . *The Rate of Interest* (The Macmillan Company, 1907).

Hafer, R. W., and Scott E. Hein. "On the Accuracy of Time-Series, Interest Rate, and Survey Forecasts of Inflation," *The Journal of Business* (October 1985), pp. 377–98.

Kessel, Reuben A. "Inflation-Caused Wealth Redistribution: A Test of a Hypothesis," *American Economic Review* (March 1956), pp. 128–41.

Keynes, J. M. *A Tract on Monetary Reform* (Macmillan and Company, 1923).

Kochin, Levis. "The Term Structure of Interest Rates and Uncertain Inflation" (University of Washington, 1981; processed).

Maisel, Sherman J., and Robert Jacobson. "Interest Rate Changes and Commercial Bank Revenues and Costs," *Journal of Financial and Quantitative Analysis* (November 1978), pp. 687–700.

Pindyck, Robert S., and Daniel L. Rubinfeld. *Econometric Models and Economic Forecasts,* 2nd ed. (McGraw-Hill Book Company, 1981), pp. 469–573.

Samuelson, Paul A. "The Effect of Interest Rate Increases on the Banking System," *American Economic Review* (March 1945), pp. 16–27.

Santoni, G. J. "Interest Rate Risk and the Stock Prices of Financial Institutions," this *Review* (August/September 1984), pp. 12–20.

________ , and Courtenay C. Stone. "Navigating Through the Interest Rate Morass: Some Basic Principles," this *Review* (March 1981), pp. 11–18.

"The Shaky Credit Structure." *Washington Post,* November 4, 1985.

Volcker, Paul A. *Statement Before the Committee on Banking, Finance and Urban Affairs, House of Representatives,* February 2, 1983.

APPENDIX 1
Some Banking Arithmetic

In large part, a bank's expected stream of net revenue is generated by its holdings of nominal assets and liabilities. These are its loans, L, which earn the market interest rate, i_m, and its deposits, D, on which interest, i_D, is paid. In addition, owners have invested capital, I, of which a fraction, α, must be held as non-interest-earning reserves against deposits, and the remaining fraction, $(1 - \alpha)$, is held in either nominal or real assets that are expected to yield the market rate, i_m. The following assumes that this remainder is held entirely in net real assets. The expected stream of net revenue, R, is given in equation 1:

(1) $R = i_m L - i_D D + i_m(1 - \alpha)I.$

If the required reserve ratio is ρ, required reserves are $\rho D = \alpha I$. The quantity of loans and deposits the bank can generate are $L = D = \alpha I/\rho$. In equilibrium, the expected revenue stream of the bank must equal the alternative stream of earnings that could be obtained by investing the capital at the market interest rate. This is shown in equation 2:

(2) $R = i_m L - i_D D + i_m(1 - \alpha)I = i_m \alpha I + i_m(1 - \alpha)I.$

The capital value of the bank, K, is shown in equation 3:

(3) $K = \dfrac{R}{i_m} = \alpha I + (1 - \alpha)I = I.$

Equation 3 expresses the capital value of the bank as the present value of the stream of expected revenue. In equilibrium, K = I. If K were greater than I, resources would be attracted to banking since the capital value of forming a bank would exceed the opportunity cost. If K were less than I, resources would leave the industry.

The Equilibrium Interest Rate on Bank Deposits

Substituting ρD for αI in equation 2 and noting that D = L, the equilibrium interest rate on bank deposits is given in equation 4:

(4) $i_D = (1 - \rho)i_m.$

Banks as Net Creditors in Nominal Assets

Net nominal assets, NNA, are nominal assets minus nominal liabilities. The bank's nominal assets are the sum of its loans and reserves, while the bank's deposits are its nominal liabilities. Assuming equilibrium, these are given in equation 5:

(5) $NNA = L + \rho D - D = \rho D.$

Under these assumptions, the bank is a net creditor in nominal assets to the extent of its reserve holdings.

APPENDIX 2
A Time-Series Forecast of Inflation

While the initial observation for the regressions reported in the text is first quarter 1962, the data period used to develop the forecast of inflation (as measured by the GNP deflator) extends back to first quarter 1948. A backward extension is necessary to get the forecasting model started.

Since the period covered is quite long, a rough check of the data was made to determine if the process that generated the time series changed materially over the period I/1948-IV/1985. To do so, a model was first estimated for I/1948-IV/1965 and these results were compared with the results obtained from estimates for I/1966-IV/1985. The GNP deflator appears to be a second-order homogeneous process that can be modeled as ARIMA (0, 2, 1). The estimated models for the two periods are reported below. Calculated t-statistics appear in parentheses, and B is a backward shift operator, i.e., $(1\text{-}B)\,X_t = X_t - X_{t-1}$.

I/1948-IV/1965

$$\Delta^2 LnP_t = -.107 + (1 - .49B)e_t$$
$$\quad\quad (.58) \quad\quad (4.73)$$

Chi-square (2, 24) = 16.07

I/1966-IV/1985

$$\Delta^2 LnP_t = .003 + (1 - .48B)e_t$$
$$\quad\quad (.03) \quad\quad (4.70)$$

Chi-square (2, 24) = 26.63

A model was then estimated for the period I/1948-IV/1961, and a forecast of inflation for I/1962 was made. The difference between the realized inflation rate for I/1962 and this forecast is interpreted as the empirical counterpart of π^u.

The forecast for the next quarter, II/1962, is generated by adding the realized inflation rate for I/1962 to the data and re-estimating the model through I/1962 and proceeding as above. The process was repeated for each quarter through IV/1985.